

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-35 are presently active in this case. Claim 1 has been amended by the present amendment to address an informality. No new matter was added.

In the outstanding Office Action, Claims 1-4, 13, 27-28, 30-31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al (U.S. Patent No. 6,188,768) in view of Lauzon (U.S. Publication No. 2004/0165808), Claims 5, 7, 14-16, 19, 21, 23-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al in view of Lauzon and further in view of Blow (U.S. Patent No. 5,757,912), Claims 6 and 8-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al in view of Lauzon and further in view of Blow and further in view of Moeller et al (U.S. Patent No. 6,538,787), Claim 11 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al in view of Lauzon and further in view of Blow and further in view of Reingand et al (U.S. Publication No. 2003/0058499), Claim 29 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al in view of Lauzon and further in view of Szafraniec (U.S. Patent Publication No. 2002/0122180), Claims 32-35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bethune et al in view of Lauzon and further in view of Blow and further in view of Foden et al (U.S. Patent Publication No. 2002/0097874). Claims 12, 17, 18, 20, and 22 were objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form.

Applicants acknowledge with appreciation the indication that Claims 12, 17, 18, 20, and 22 include allowable subject matter. However, since Applicants consider that the

amended independent claims are allowable, Claims 12, 17, 18, 20, and 22 have presently been maintained in dependent form.

Claim 1 as clarified defines:

A photon emitter comprising:
a photon generator configured to generate randomly polarized photons separable into a first polarisation state and a second polarisation state, the first polarisation state being orthogonal to the second polarisation state; and
time delay means receiving said randomly polarized photons and being configured to delay photons having the second polarisation state with respect to those having the first polarisation state such that *photons which enter the time delay means with the first polarisation exit the time delay means at a different time to photons which enter the time delay means with the second polarisation*. [Emphasis added.]

Regarding Bethune et al, the "time delay means" of Bethune et al is part of an interferometer of a quantum communication system. The Office Action asserts that the two pulses in Bethune et al exit at different times. However, this assertion goes against the whole teaching of Bethune et al.

Bethune et al describe a balanced interferometer. Bethune et al's Figure 2 (reproduced below) shows a polarising beam splitter 46 which ensures that any vertically polarised photons outputted by diode laser 12 are rejected. (See column 5, lines 7 to 9.) The horizontally polarised photons are then converted to photons with polarised states of $\pm 45^\circ$. These *polarised photons* then impinge on beam splitter PBS 1 and are either directed along path (1) into delay line 18 followed by the path to second channel end 20 or are directed along path (2) to second channel end 20. These *polarised photons* are then reflected back by Faraday mirror 22 back through complementary paths to PBS 1. In other words, the Faraday mirror 22 constitutes the main reflective side of the balanced interferometer of Bethune et al. There is *no exit* from the balanced interferometer of Bethune et al on the right-hand side of PBS 1.

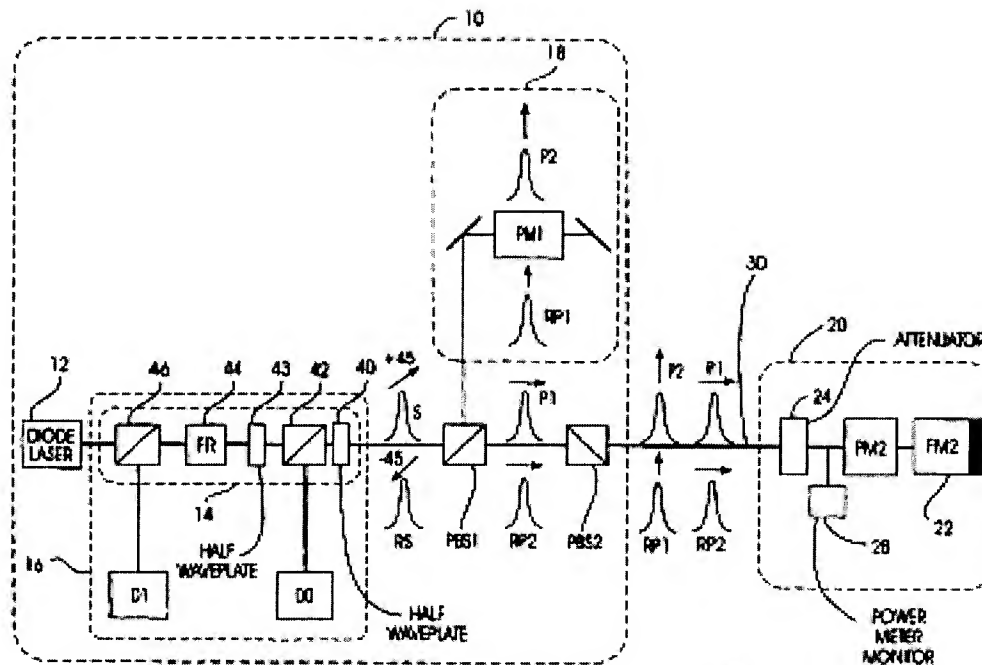


FIG. 2

Thus, although the *polarised photons* follow two paths through the system, it is the polarized photons in Bethune with well-defined polarizations (and not randomly polarized photons as claimed) that travel these paths. More importantly, these *polarised photons* which are reflected by Faraday mirror 22 travel respectively back through the complementary paths such that, when the *polarised photons* exit the interferometric section at PBS 1, they have traveled “precisely the same distance.” Bethune et al describe at col. 6, lines 6-28, that:

The two pulses on their return to the first channel end 10 are designated as a pair of return pulses RP1 and RP2, and are separated by the same time delay as applied at the first channel end 10, but with the second return pulse RP2 having a phase shift applied by PM2. As shown in FIG. 2, the return pulses RP1 and RP2 have their polarizations rotated 90 degrees from their corresponding pulses P1, P2 when they arrive back at PBS2, because of the orthogonal polarization rotation applied by FM 22. Because RP1 now has vertical polarization when it reaches PBS2, at the first channel end 10 it is directed through delay stage 18 and phase modulator PM1 where the first user at channel 10 may apply phase modulation. The second pulse RP2, which now has horizontal polarization, passes through PBS2 and reaches PBS1. *Because each of the pair of pulses has traveled precisely the same distance from PBS1 to the Faraday mirror 22 and back to PBS1*, the return

pulse RP1 and the return pulse RP2, which has passed through delay stage 18, will recombine at PBS1 into a single return signal designated RS. Signal RS will have a polarization state that is determined by the difference of the phase shifts imparted to P2 and RP1 by PM2 and PM1, respectively, prior to their recombination at PBS1. [Emphasis added.]

In other words, the pulses follow optical paths of the same distance before arriving at detector stage 16 where detectors D0 and D1 where all of the returned light is directed entirely into one of D0 or D1. (See column 7, lines 12-20.) Accordingly, the pulses in Bethune et al do **not** exit the system at different times. If the pulses exited at different times, there would be no interference, and Bethune et al would not work.

Regarding Lauzon, Lauzon was applied in the Office Action for an asserted teaching of a time delay means for receiving photons with unknown polarization. Lauzon is not a quantum system and relates to transforming a classical non-polarised signal into a polarised signal. However, in Lauzon, this transformation is achieved using an interferometer which ensures that "there are no delays between the signals in the two interferometer arms" (see Abstract of Lauzon). This is clearly different from the photon emitter of Claim 1 which is a source where the photons can be used in a polarisation sensitive environment, but where it is still nonetheless possible to identify the initial polarisation of the photons due to the time delay introduced by the emitter for photons of different polarisations.

Moreover, even if it were proper for the examiner to selectively choose (apparently by hindsight reconstruction) the "time delay means" of Lauzon to apply to the interferometer of Bethune et al, such a substituted time delay means would still only receive ***polarised photons***. Thus, the asserted combination would still not meet the claimed time delay means receiving randomly polarized photons.

To meet this claim element would mean 1) the substantial reconstruction and redesign of the elements shown in Bethune et al and 2) a change in the basic operating principle of Bethune et al to where Bethune et al would **not** reject any vertically polarised photons (as discussed above). In re Ratti, 270 F.2d 810, 813, 123 USPQ 349, 352 (CCPA 1959) reversed an obviousness rejection where the "suggested combination of references would require a substantial reconstruction and redesign of the elements shown in [the primary reference] as well as a change in the basic principle under which the [primary reference] construction was designed to operate."

Thus, the deficiencies in Bethune et al discussed above are not overcome by Lauzon.

M.P.E.P. § 2143.03 requires that all words in a claim must be considered in judging the patentability of the claim against the prior art. M.P.E.P. § 2123 I states that a reference may be relied on for all it would have reasonably suggested to one having ordinary skill in the art, including non-preferred embodiments. Here, there is no disclosure or reasonable suggestion in the applied art of:

- 1) time delaying randomly polarized photons received from a photon generator generating randomly polarized photons, or
- 2) delaying photons having the second polarisation state with respect to those having the first polarisation state such that photons which enter the time delay means with the first polarisation exit the time delay means at a different time to photons which enter the time delay means with the second polarization.

Thus, the applied art does not make obvious the photon emitter of Claim 1.

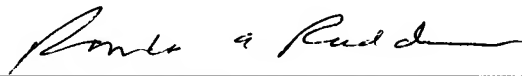
Independent Claims 14, 27, and 31 define features similar to those discussed above with regard to Claim 1.

Accordingly, independent Claims 1, 14, 27, and 31 (and the claims dependent therefrom) are believed to patentably define over the art of record.

Consequently, in view of the present amendment and in light of the above comments, no further issues are believed to be outstanding, and the present application is believed to be in condition for allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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